Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (DS99029)

1998 Buick Century

California

June, 1998

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16. Abstract

This remote investigation focused on the redesigned air bag system deployment of a 1998 Buick Century. The case was generated through the Fatal Accident Reporting System. The driver and the rear left occupant in the case vehicle were fatally injured in this single vehicle crash. The case was conducted as a remote investigation. This crash occurred during the late evening hours in June, 1998. The crash occurred on a sharply curved, two-lane, two-way undivided roadway. The curve has a critical curve speed of 11.4. The speed limit in this area is 40 km/h (25 mph). The roadway was lit by streetlights and light from nearby businesses.

The case vehicle, a 1998 Buick Century four-door sedan driven by an unrestrained 34-year-old male, was traveling westbound into a right hand curve. The case vehicle was equipped with anti-lock brakes. The front right seat was occupied by a restrained 36-year-old male (02). The rear left seat was occupied by an unrestrained 61-year-old male (03). The rear right seat was occupied by an unrestrained 46-year-old male (04). The case vehicle was equipped with driver and front right passenger air bags. For unknown reasons, the driver of the case vehicle began accelerating through the curves. The case vehicle passed a non-contact vehicle on the left. As the case vehicle entered the right hand curve, the driver lost control and the vehicle began a slight clockwise yaw. The case vehicle struck and over-rode the curb on the left side of the roadway and, according to the police, struck a metal air vent. The case vehicle continued onward until striking a large palm tree with the front left of the vehicle (12FYEW5). The case vehicle sustained a longitudinal delta v of -58.4 km/h (-36.3 mph) and a latitudinal delta v of 5.1 km/h (3.2 mph). The case vehicle rotated about the tree in counterclockwise direction and came to rest in the street facing north.

The driver and rear left passenger were declared deceased at the scene. The front right and right rear passengers were stabilized at the scene and then transported to a local area trauma center by ground ambulance.

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Summary

This remote investigation focused on the redesigned air bag system deployment of a 1998 Buick Century. The case was generated through the Fatal Accident Reporting System. The driver and the rear left seat occupant in the case vehicle were fatally injured in this single vehicle crash. The case was conducted as a remote investigation. This crash occurred during the late evening hours in June, 1998. The crash occurred on a sharply curved, two-lane, two-way undivided roadway. The curve has a critical curve speed of 11.4[1]. The speed limit in this area is 40 km/h (25 mph). The roadway was lit by streetlights and light from nearby businesses.

Crash Events

The case vehicle, a 1998 Buick Century four-door sedan driven by an unrestrained 34-year-old male, was traveling westbound into a right hand curve. The vehicle was equipped with anti-lock brakes. The front right seat was occupied by a restrained 36-year-old male (02). The rear left seat was occupied by an unrestrained 61-year-old male (03). The rear right seat was occupied by an unrestrained 46-year-old male (04). This vehicle was equipped with driver and front right passenger air bags. For unknown reasons, the driver of the case vehicle began accelerating through the curves. The Buick Century passed a non-contact vehicle on the left. As the Buick entered the right hand curve, the driver lost control and the vehicle began a slight clockwise yaw. The Buick struck and over-rode the curb on the left side of the roadway and, according to the police, struck a metal air vent. The vehicle continued onward until striking a large palm tree with the front left of the vehicle (12FYEW5). The Buick sustained a longitudinal delta v of -58.4 km/h (-36.3 mph) and a latitudinal delta v of 5.1 km/h (3.2 mph)[2]. The vehicle rotated about the tree in counterclockwise direction and came to rest in the street facing north.

Figure 1. Final rest, case vehicle

[1]See attachment 1 for calculations

[2]Calculated using CDC-only versus barrier

The driver and rear left passenger were declared deceased at the scene. The front right and right rear passengers were stabilized at the scene and then transported to a local area trauma center by ambulance.

Table 1. Delta V

	Case Vehicle	
	km/h	mph
Total	58.6	36.4
Longitudinal	-58.4	-36.3
Lateral	5.1	3.2

Exterior of Case Vehicle

Table 2. Vehicle Information

Model year, make and model	1998 Buick Century
VIN	2G4LUS52MXWXXXXXX
CDC	12FYEW5

Figure 2. Exterior, case vehicle

Table 3. Crush Measurements

Plane of Impact	Field L cm/in.	C1 cm/in.	C2 cm/in.	C3 cm/in.	C4 cm/in.	C5 cm/in.	C6 cm/in.
Bumper	Not available, however police indicate that there was 106 cm (42 in.) of indentation (crush) to the front end.						

Interior of Case Vehicle

The interior of the case vehicle sustained severe damage. The left A-B pillars were cut by rescue personnel. Due to the lack of on-scene vehicle data, the degree of passenger compartment intrusion could not be ascertained; however, there was substantial rearward intrusion of the left instrument panel, as well as intrusion forward into the front left and front right seating positions due to movement of the rear occupants. The windshield was damaged due to the impact force. The front left door was jammed and needed to be opened using hydraulic spreaders.

This six passenger vehicle is equipped with a cloth split bench front seat with manual recliners, while the second row is equipped with a bench seat. The two frontal seat backs are equipped with adjustable head restraints; both the head restraints and the seat backs were pushed forward by the rear seat occupants. The vehicle was equipped with a tilt steering wheel which was deformed by occupant contact.

Table 4. Intrusions

Intruded Component	Location of Intrusion	Intruded Value cm/in.		Dominant Crush Direction
Left instrument panel	Front left	Unknown	Unknown	Longitudinal
Seat back	Front left	Unknown	Unknown	Longitudinal
A-pillar	Front left	Unknown	Unknown	Longitudinal
Seat back	Front right	Unknown	Unknown	Longitudinal
Toe pan	Front left	Unknown	Unknown	Longitudinal

Case Vehicle Occupant Protection Systems

The 1998 Buick Century was equipped with dual redesigned/depowered air bag units. There is an air bag module located in the front left (steering wheel hub) and front right instrument panel which house the air bags and inflator units. The driver air bag module is housed in the steering wheel hub and is concealed by an "I" shaped cover. The driver air bag module is equipped with one inflator and a circular nylon air bag.

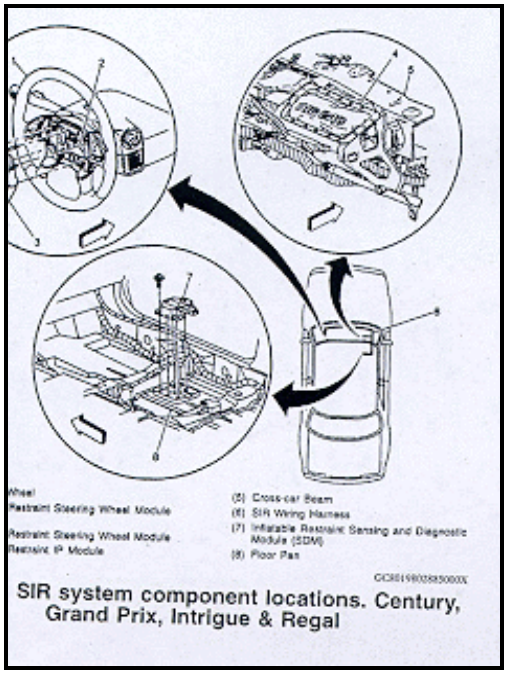


Figure 3. SRS Component Locations

Case Vehicle Occupant Demographics

	Occupant 1		Occupant 2		Occupant 3		Occupant 4	
Age/Sex:	34/Male		36/Male		60/Male		46/Male	
Seated Position:	Front left		Front right		Rear left		Rear right	
Seat Type:	Split bench		Split bench		Bench		Bench	
Height (cm/in:):	183	72	Unk	Unk	185	73	Unk	Unk
Weight (kg/lbs).:	84	185	Unk	Unk	86	190	Unk	Unk
Pre-existing Medical Condition:	None noted		Unknown		None noted		Unknown	
Body Posture:	Unknown		Unknown		Unknown		Unknown	
Hand Position:	Both hands presumed to be on wheel		Unknown		Unknown		Unknown	
Foot Position:	Right presumed to be on brake		Unknown		Unknown		Unknown	
Restraint Usage:	None used		Lap and shoulder used		None used		None used	
Air bag:	Deployed		Deployed		None		None	

Occupant Injuries

Table 5. Injuries. Driver (Occupant 1)

Injury	Injury Severity (AIS)	Injury Mechanism
Open fracture, right lateral orbital ridge	251204.3,1	Steering wheel rim
Open Le Forte I fracture, interior maxilla with laceration of gingiva	250804.2,8	Steering wheel rim
Full thickness tear of lower lip	290600.1,8	Steering wheel rim
Rib fracture: right lateral (7), left posterior (7), left lateral (11)	450220.2,2 450212.1,1	Steering wheel
Lung contusions: right posterior upper, middle, and lower lobes; left medial lobe.	441410.4,3	Steering wheel
Aortic tear, massive, at the posterior arch involving the proximal descending.	420299.4,4	Steering wheel
Left side hemothorax (1000-2000 cc)	Captured with lung contusions	NA
Right side hemothorax (est. 100 cc)	Captured with lung contusions	NA
Hemoperitoneum (est. 100 cc)	Not codeable, information exists for a specific anatomical lesion.	NA
Torn spleen	544220.2,2	Steering wheel rim
Torn/fragmented liver (both lobes)	541820.2,1	Steering wheel rim
Torn diaphram	440604.3	Steering wheel rim
Hemomediastinum	Not codeable, information exists for a specific anatomical lesion.	NA
Abrasions, right hand, posterior finger webs	790202.1,1	Unknown
Scrotal abrasions	544099.1,8	Unknown
Bilateral testicular contusions	544610.1,8	Unknown
Abrasion, left knee, 6 in.	890202.1,1	Left instrument panel
Abrasion, left shin, 7 in.	890202.1,2	Left instrument panel

Table 6. Injuries (02)

Injury	Injury Severity (AIS)	Injury Mechanism
Chest contusions	490402.1,9	Seat belt
Chest pain	Not codeable	
Abdominal pain	Not codeable	

Table 7. Injuries (03)

Injury	Injury Severity (AIS)	Injury Mechanism
Nasal fracture	251000.1,4	Possibly center instrument panel
Possible basal skull fracture	Not codeable	NA
Open fracture, maxillary arch	250800.2,9	Possibly center instrument panel
Open chop fracture, mandible. Comminuted and displaced.	250610.2,9	Possibly center instrument panel
Abrasion, left hand	790202.1,2	Unknown
Abrasion, right hand	790202.1,1	Unknown
Abrasion, left knee	890202.1,2	Rear of left front seat
Abrasion, right knee	890202.1,1	Center console
Abrasion, left lower shin	890202.1,2	Rear of left front seat
Abrasions under chin	290202.1,8	Possibly center instrument panel
Bilateral eye contusions	210402.1,1 210402.1,2	Possibly center instrument panel
Abrasions/lacerations to face	290202.1,9 290600,1,9	Possibly center instrument panel
Abrasions/lacerations to left upper cheek	290202.1,2 290600.1,2	Seat back
Abrasions/lacerations left lower jaw	290202.1,2 290600.1,2	Seat back

Table 8. Injuries (04)

Injury	Injury Severity (AIS)	Injury Mechanism
Facial fracture	250400.1,9	Unknown, possibly B pillar,

Occupant Kinematics

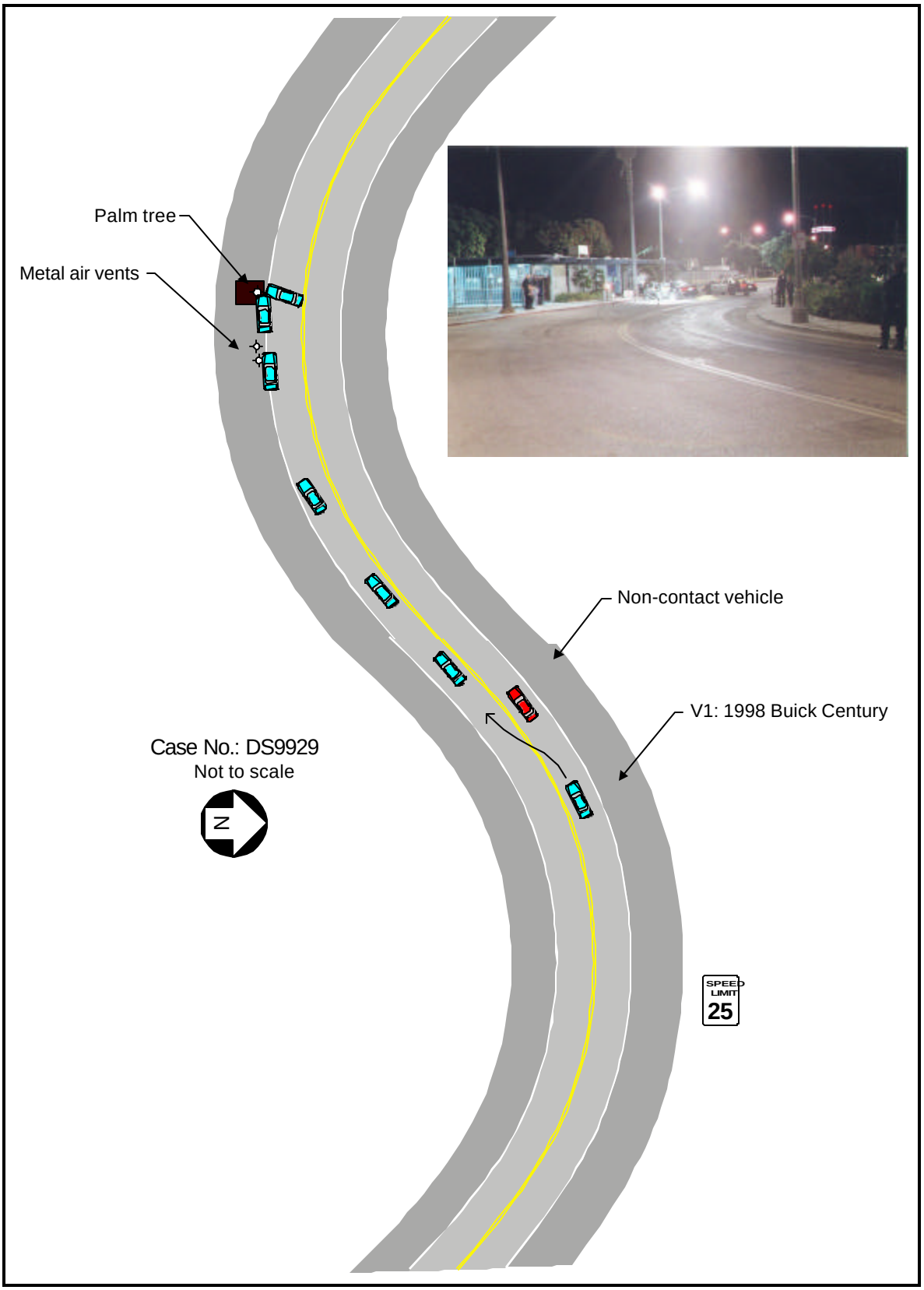
The front left occupant was presumed to be sitting in an upright, normal position. He was not wearing the available lap and shoulder belt. He was actively steering the case vehicle to the right and was likely braking at the same time. The slight clockwise yaw would have caused him to lean toward the left to some extent. The shallow angle contact with the curb did not influence the vehicle path to any appreciable degree. At impact, this occupant pitched forward as the vehicle rotated beneath him–causing him to strike and load the air bag and steering wheel in an offset to the right fashion. The rear of the driver's seat back was struck by the left rear occupant–loading the occupant on the right side. This motion, combined with the crash motion, forced this occupant's face into and through the deploying air bag–causing the occupant to strike the upper rim with his face and the lower rim and hub with his chest/abdomen. This occupant died at the scene.

The front right occupant was presumed to be sitting in an upright, normal position. He was wearing the available lap and shoulder belt. The slight clockwise yaw of Vehicle 1 would have caused him to lean toward the left to some extent. At impact, this occupant pitched forward, loading the seat belts–likely causing the chest contusions.

The rear left occupant was presumed to be sitting in an upright, normal position. He was not wearing the available lap and shoulder belt. The slight clockwise yaw of Vehicle 1 would have caused him to lean toward the left to some extent. At impact, this occupant pitched forward as the vehicle rotated beneath him. This motion caused the occupant to only partially engaged the rear of the front left seat–causing the lower extremity contusions. The occupant continued forward into the center portion of the front compartment and struck a hard object (likely the center instrument panel) with his face–causing the facial fractures. This occupant died at the scene.

The rear right occupant was presumed to be sitting in an upright, normal position. He was not wearing the available lap and shoulder belt. The slight clockwise yaw of Vehicle 1 would have caused him to lean toward the left to some extent. At impact, this occupant pitched forward as the vehicle rotated beneath him. This occupant sustained a facial fracture of some sort. One likely point of contact in this configuration would be the "B" pillar.

Scene Diagram



Attachment 1.

Critical Speed of a Curve or path of vehicles center of mass
when radius, Drag Factor and Superelevation/Grade are known.
Length of Chord = 25 feet
Middle Ordinate of Chord = 12 feet
Coefficent of Friction = .7
Superelevation/Grade = .00

Radius of a Curve
$R = (C^2/(8*m))+(m/2)$
$R = (25^2/(8*12))/(12 / 2)$
$R = 625.00/96.00 + 6.00$
$R = 6.51 + 6.00$
$R = 12.51$
The radius of the curve is 12.51 feet

Critical Speed of the Curve or Vehicle's Center of Mass
$S = 3.86 * Sqr(R *(f\pm e))$
$S = 3.86 * Sqr(12.51 *(.7 \pm .00))$
$S = 3.86 * Sqr(12.51 *(0.70))$
$S = 3.86 * Sqr(8.76)$
$S = 3.86 * 2.96$
$S = 11.42$
Critical Speed of the Curve is 11.42 MPH